HL 9: Nitride: Preparation, Charakterization and Devices

Time: Tuesday 11:45–12:30 Location: H4

HL 9.1 Tue 11:45 H4

AlPN on GaN: A new barrier material for HEMTs — •Markus Pristovsek and Yuto Ando — IMaSS, Nagoya University, Japan

We report on the ternary alloy wurzite AlP_yN_{1-y} on (0001) GaN, grown by metal-organic vapor phase epitaxy. AlPN is lattice matched to GaN at about 11% P content, while having a larger bandgap than AlInN. Furthermore, AlPN is grown in H_2 at similar temperatures as GaN, avoiding long growth interruptions and temperature ramping. Unlike AlInN, Ga carry over is not an isssue. Finally, there is tertiarybutylphosphine (tBP), a proven metal-organic precursor with a high vapor pressure which is not available for AlScN. Therefore, AlPN looks like a promising material to replace AlGaN as barrier layer in high electron mobility transistors (HEMT) especially for high frequency applications. First results confirmed high sheet carrier densities, and highlighted the crucial influence of strain to avoid point defects. As with any new material there are new challenges, most notably the growth transitions between the binary GaN and the group V alloy AlPN and avoiding detrimental effects on growth and background doping from residual P in GaN.

HL 9.2 Tue 12:00 H4

Low-temperature internal quantum efficiency of GaInN/GaN quantum wells under steady state conditions — •Shawutijiang Sidikejiang[1], Philipp Henning[1,2], Philipp Horenburg[1], Heiko Bremers[1,2], Uwe Rossow[1], Dirk Menzel[3], and Andreas Hangleiter[1,2] — [1]Institut für Angewandte Physik, Technische Universität Braunschweig — [2]Laboratory for Emerging Nanometrology, Technische Universität Braunschweig — [3]Institut für Physik der Kondensierten Materie, Technische Universität Braunschweig

In this work, we compared the low-temperature PL intensities of a range of QW samples under identical conditions, mounting the samples side by side. Normalizing the measured intensity to the absorbed power density in the QWs, we find that the PL efficiencies of several samples, which the 100% internal quantum efficiency (IQE) can be confirmed by the temperature-dependent lifetime measurements from time-resolved PL (TRPL), are identical under steady-state PL excitation. On the other hand, for samples with a reduced low-temperature IQE observed in TRPL, the PL efficiencies saturate at significantly lower values. The experimental results confirm a unity IQE at low temperature for those efficient samples, but also allow to estimate the absolute IQE of samples with a lower efficiency by a direct comparison. The latter case is investigated by studying the influence of point defects due to Ar implantation on the low-temperature PL efficiency of the QWs.

HL 9.3 Tue 12:15 H4

Structural analysis of novel orientations of AlN grown on *m*-plane sapphire — •Jochen Bruckbauer[1], Gergely Ferenczi[1], Humberto Foronda[2], Sarina Graupeter[2], Ben Hourahine[1], Aimo Winkelmann[1,3], Zhi Li[4], Ling Jiu[4], Jie Bai[4], Tao Wang[4], Tim Wernicke[2], Michael Kneissl[2], and Carol Trager-Cowan[1] — [1]University of Strathclyde, UK — [2]Technische Universität Berlin, Germany — [3]AGH University of Science and Technology, Poland — [4]University of Sheffield, UK

Heteroepitaxial III-nitrides can be grown with a wide range of orientations on a range of substrates. Determination of the epitaxial orientation relationship of the nitride film with its substrate is often necessary. Here, we report on the determination and observation of novel orientations in AlN grown on *m*- or $(1\bar{1}00)$ plane sapphire using electron backscatter diffraction (EBSD). An electron backscatter diffraction pattern is recorded for each spatial point in an EBSD map from which crystal structure, orientation and misorientation can be determined with a spatial resolution of around 50 nm and a relative angular precision of around 0.1°. The AlN thin film exhibits twinned regions where the normal to a $\{1\bar{2}13\}$ plane for each twin is within 9° of the $[1\bar{1}00]$ sapphire direction. The twins share a common $\{1\bar{1}00\}$ plane. Furthermore for each twin, the normal to a $\{11\bar{2}2\}$ AlN plane is within 3.5° of the $[11\bar{2}0]$ sapphire direction and a $\langle\bar{4}312\rangle$ AlN direction is within 2° of the [0001] sapphire direction. These orientations, together with the usually observed $(1\bar{1}00)$ and $(11\bar{2}2)$ cases, form a family of related growth directions for nitride thin films.